SALTON SEA REVITALIZATION & RESTORATION

Salton Sea Authority Plan for Multi-Purpose Project

Ecological Features and Selenium Management

Salton Sea Authority

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Ecological Features and Selenium Management

The Authority Plan will provide the ecological benefits of a large deep-water lake with ocean-like salinity and good water quality coupled with shallow water features in areas that currently provide some of the best shallow water habitat in the existing Sea. The concept of a large lake in the desert is the historical feature that singularly established the Salton Sea as a paradise for over 400 species of birds. The nearly 160-sq.-mile lake area with depths exceeding 50 feet in the Authority project design will once again provide an abundant food source for fish eating birds that reside at the Sea or migrate along the Pacific Flyway. This is a critical project feature because deep anoxic water – as currently exists in the 50-ft-deep basins in the north and south ends of the present Sea - is required to perpetuate the selenium assimilation effect that has made selenium a non-issue with respect to wildlife impacts for a 100 years (USGS, 2003).

In addition to the habitat values provided by two multi-purpose lakes, the Authority project design includes (1) a 16,000-acre saline habitat complex in the south, (2) a 1,800-acre saline habitat complex by the Whitewater River delta, (3) dedicated habitat zones in both lakes, and (4) wildlife disease prevention program. These ecological features and Plan's unique selenium management capability are presented below. The habitat features and risk prevention measures in the Authority project design are collectively intended to provide the diversity, dispersion, quality, and quantity of habitat types necessary to achieve the "maximum feasible attainment" of the Salton Sea ecosystem restoration goals set out in State law.

Saline Habitat Complex

The creation of shallow salt-water habitat is an integral component of a comprehensive ecosystem restoration strategy incorporated into the Authority project design. As a compensating factor for the unavoidable elimination of approximately 165,000 acres of water surface area due to the inflow reductions, the Authority has included a 16,000-acre "Type 3" (Figure 1) shallow-water saline habitat complex (SHC) in the Authority project plan. This Type 3 SHC configuration was selected over the Type 1 and 2 configurations that include 20-ft-deep ponds because the 16,000 acres of 0-to-20-ft-deep lake water in the dedicated habitat zone in the south lake in the Authority project design obviates the need for deep ponds within the SHC itself.

Creation of a 16,000-acre shallow-water saline habitat complex would allow for reclamation of flooded areas of the Sony Bono Salton Sea National Wildlife Refuge (SBSSNWR) and provide significantly more shallow-water habitat than currently exists at the Sea. It is envisioned in the Authority Board Policy Positions that, as part of the Authority Plan, the SBSSNWR would be reconfigured to include this 16,000-acre saline habitat complex and

the 16,000-acre eastern half of the new south estuary lake. Under this scenario, the U.S. Fish & Wildlife Service (USFWS) would be free to design the saline habitat complex and/or make changes in the design of the south lake to maximize habitat values based on its expertise and knowledge. Water management priorities would be established to ensure that the SHC has high priority for receiving water during low inflow periods. Such priorities would work with the overall plan since it would be necessary to maintain an outflow from the lake to the SHC area to control salinity levels in the large lake.

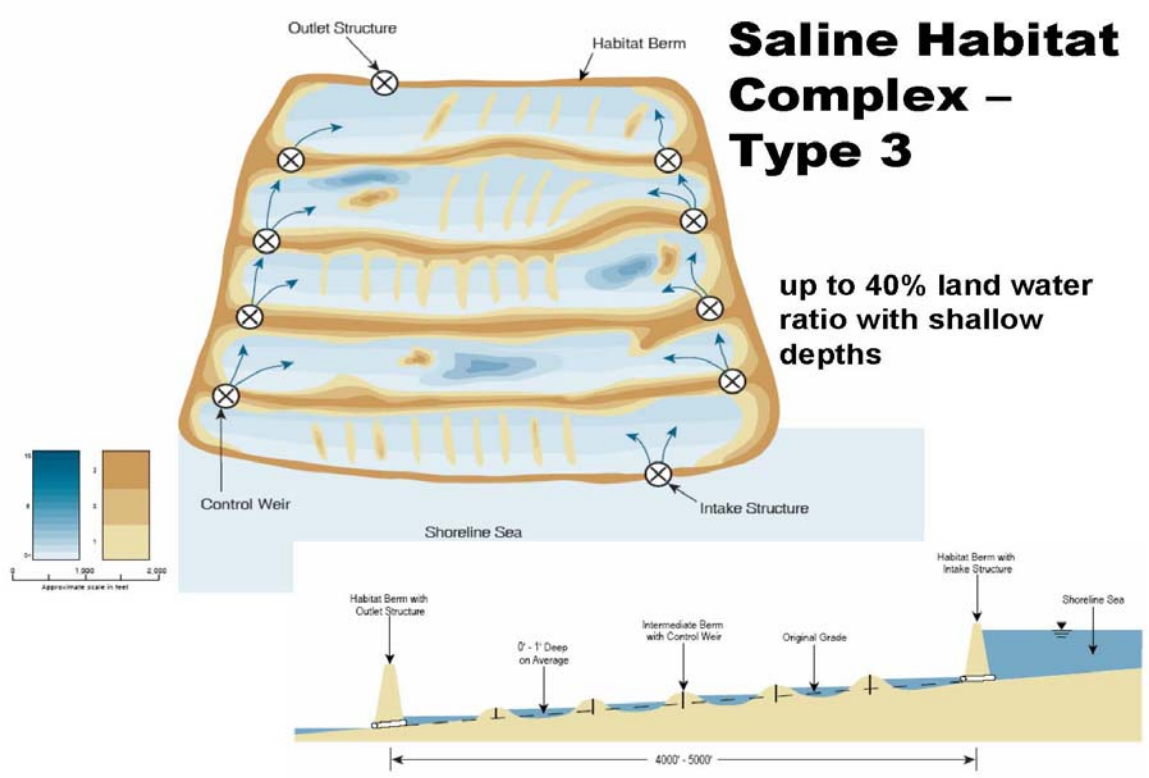

Figure 1. Schematic Drawing of Type 3 Saline Habitat Complex. Source: CH2M Hill, 2005.

A key issue in the design and operation of any SHC is the selenium concentration of the feed water. As noted earlier in this report, the Authority included 20,000 acres shallow brackish-water and saline-water habitat areas around the south basin in its original North Lake Plan. These areas were designated to be watered with New and Alamo River water (selenium concentrations ranging from 5 to 12 µg/L), Salton Sea water (selenium concentration of 1-2 µg/L), or a combination of both sources. The team of experts that reviewed the Authority's North Lake Plan in November 2005 included persons with direct knowledge of the selenium toxicity problems encountered at the Kesterson National Wildlife Refuge in Merced County in the 1980s when agricultural drainwater was used for watering habitat areas. In their written report, these experts specifically directed the Authority *not to*

use New and Alamo River water, or a combination of river water and Sea water, to water any habitat areas (Pacific Institute, 2006).

Reclamation and the USGS Salton Sea Science Office are currently conducting a pilot project to investigate created shallow habitat using a combination of Alamo River water and water from the Salton Sea. The investigation will include an analysis of selenium bioaccumulation. Information from the shallow habitat pilot project will be helpful in developing the final designs for the SHC. As currently planned, the Authority has sized the SHC in its project plan and has developed its water management strategy using saltwater discharged from the north lake with projected selenium concentration of 1-2 μg/L as the primary supply for SHC areas. Additional brackish water from the south lake area will be blended to complete the supply for the SHC. The Authority has assumed that about 50% of the 16,000 acre SHC are in the south would be wet, whereas the State has assumed 60% would be wet as shown in Figure 1. Slight adjustments to the dike configuration in the Authority Plan would allow for the additional 10,000 AFY that would be needed for the added wet area.

Early Start for Habitat Features

As the inflow to the Sea declines in the future and the surface area begins to shrink, salts and other constituents will become more concentrated providing greater stress to the existing fish populations. Therefore, the ability to create habitat features early in the implementation process will be an important element for any Salton Sea revitalization plan. The area designated for the SHC in the southern area of the current Salton Sea could be contoured through hydraulic dredging. As the Sea recedes, the contoured areas would serve as the pools and islands shown in Figure 1. A pump system would be installed to bring salty lake water to the upper reach of the SHC and then blend with river water to serve as the water supply for the complex. Salinity management would be accomplished by the blend and may vary seasonally or be adjusted through an adaptive management process. The shallow habitat pilot project being conducted by Reclamation and the USGS Salton Sea Science Office uses such a pumping system that blends lake water with river water to provide a gradient of salinities across the project area.

Construction of the SHC could be accomplished in phases and could commence as soon as the design and environmental compliance and permitting process is completed. Figure 2 illustrates a conceptual phasing plan. This plan shows diked areas along five-foot contours. Under this scheme, hydraulic dredging would be used to contour the area of Phase 1 to create areas that would become pools and islands as the Sea level recedes. Dredge spoil would be placed along the five-foot contour lines to serve as berms. As the lake level retreats and the first phase is completed, dredging could begin in the second phase area and the process would be repeated until the entire SHC is complete.

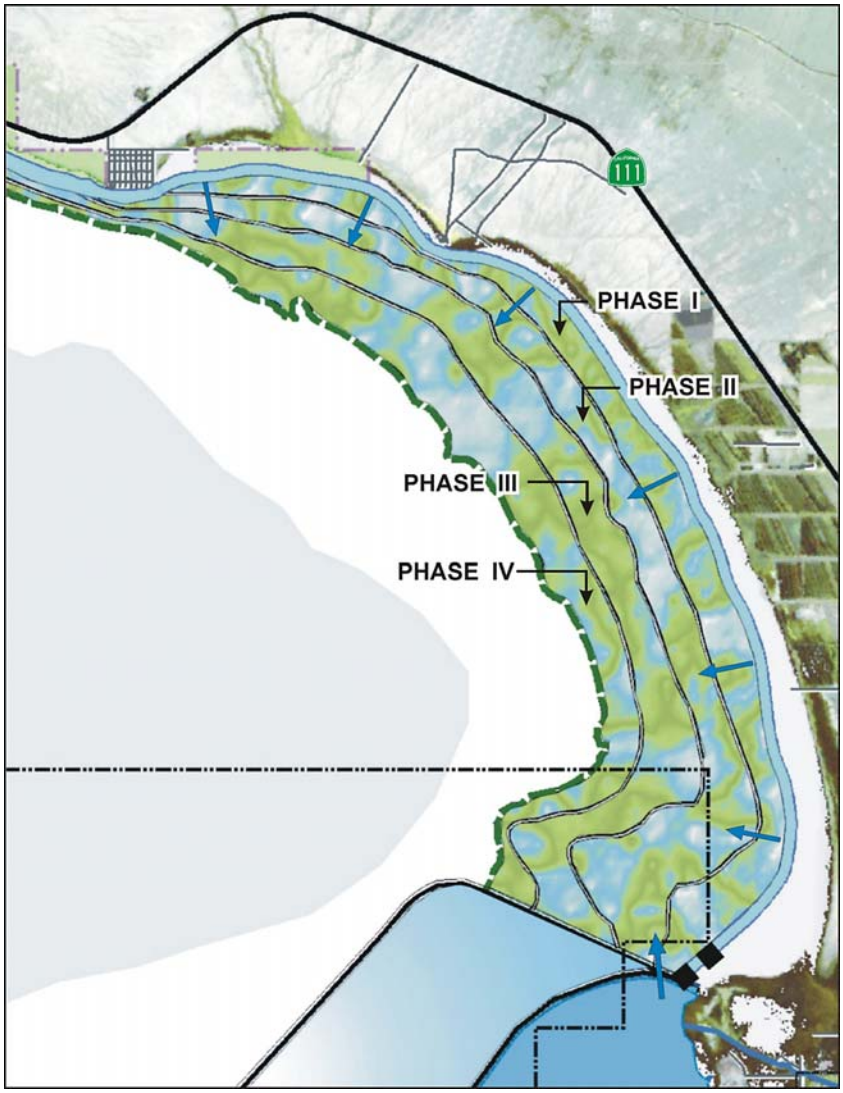

Figure 2. Potential Phasing to Allow Early Construction of Saline Habitat Complex.

The timeline for the Authority Plan is being developed to show the construction of these areas at the earliest practical time with appropriate budget. Specific details about the construction plan will be developed at the next phase of design during the site-specific EIR process.

Dedicated Habitat Zones

Dedicated Habitat Zones are proposed along the central embankment and on the eastern side of the south lake area. The zone in the south is a no-motorized-boating zone and the zone along the center dike is a no-boating zone. Both would be designated by buoys and the latter may include booms or a floating chain. No special water quality or flow controls would be required. The no-boating zone along the dike also includes safety considerations for seismic events. These areas would offer less disturbance to wildlife than other areas where motorized boating would be allowed.

Wildlife Disease Control

The Authority's comprehensive restoration strategy includes an integrated approach to wildlife disease control to reduce the incidences of wildlife disease at the Sea. Avian disease at the Salton Sea has been a chronic problem resulting in an annual loss of several thousand birds. Major epizootics (quickly spreading disease among animals) increased in frequency during the 1990s, which greatly increased the level of losses. During 1992, more than 150,000 eared grebes (*Podiceps nigricollis*) died during a single event of undetermined origin. The deaths of thousands of white pelicans (*Pelecanus erythrorhynchos*) and more than 1,000 endangered California brown pelicans (*P. occidentalis*) during 1996 from type C avian botulism focused national attention on the Salton Sea. This event served as a catalyst to begin the current Salton Sea Restoration Project.

Other diseases affecting birds of this ecosystem are avian cholera, Newcastle disease, and salmonellosis. Algal toxins are a suspected, but unproven cause of grebe mortality. Outbreaks of avian cholera affect a wide variety of bird species and have become annual events, causing the greatest losses in waterfowl, eared grebes, and gulls. Newcastle disease devaStated the Mullet Island double-crested cormorant (*Phalacrocrax auritus*) breeding colony at least twice during the 1990s. Salmonellosis has been primarily a cause of mortality in breeding colonies of egrets. Several other diseases have also been diagnosed as contributing to avian mortality at the Sea.

USFWS, with support from DFG, have conducted an on-going program to combat disease at the Salton Sea by providing response to bird die-offs. An initiative of the Salton Sea Restoration Project in the early 2000s to augment USFWS surveillance efforts enhanced the early detection of disease, and was another successful first step in minimizing losses. The existing efforts and activities are important steps to address disease impacts and should be continued and enhanced. Major bird mortality events have essentially not occurred in the past several years.

An enhanced approach that provides a continual interface between environmental monitoring, disease surveillance and response, and scientific investigations of disease ecology would be the next step. Expanded wildlife rehabilitation would also be provided because the avian botulism problem continues to affect pelicans at the Salton Sea. Therefore, the goal for the long-term disease control effort would be to provide an integrated approach to controlling wildlife disease (including fish and birds) at the Salton Sea in a manner that enhances opportunities for wildlife managers to minimize disease events and associated losses. This approach would include programs to monitor environmental conditions; detect, diagnose, and respond to disease events; collect and rehabilitate afflicted wildlife; and further development of a sound understanding of disease ecology at the Sea.

Selenium Management

The Authority believes its project plan provides the best configuration for retaining the Sea's historical capacity to assimilate the estimated 10 tons/year of selenium that flows into the Sea each year along with the agricultural drainage water (Setmire, 1998)[1]. This is an important, and in the Authority's opinion overriding, factor in selecting a preferred restoration project design that receives State and possibly Federal funding.

The Authority has reviewed treatment technologies for removal of selenium from agricultural drainage flows and New and Alamo River water. The Authority staff met with IID staff, various technology vendors, and the project manager for Reclamation's San Luis Drainage Features Reevaluation (SLDFR) project in the San Joaquin Valley. Reclamation's SLDFR project is relevant since this project included the field pilot testing of a biological selenium removal process that is now a component of Reclamation's "preferred project" approach for removing selenium from agricultural drainage water in the San Joaquin Valley. After investigation of the potential applicability of this process under various schemes to the situation at the Salton Sea, Authority staff concluded, and DWR staff concurred, that treatment technology is infeasible as a selenium management strategy at the Salton Sea. (IID and Reclamation had reached this same conclusion in their EIS/EIR for the Transfer Project/QSA in 2002.) Accordingly, the Authority Plan relies on the source of water for the SHC which is most likely to be the lowest in selenium, i.e. the lake water, as discussed above.

The State Board and others have formed collaborative partnerships for implementing selenium source control efforts within the upper basin States on the Colorado River system (Utah, Colorado and Wyoming) that are the original source of the selenium that eventually makes it way into the Salton Sea (SWRCB, 2006). These efforts have had only nominal success, and the possibly of achieving significant reductions in the future is improbable unless large acreages of farmland in the upper basin States are taken out of production. This is not likely to happen. (Comments by upper basin officials at the WEF-sponsored Selenium Summit in November 2005.)

Since treatment and source control are not feasible, the only feasible long-term solution to the selenium management issue at the Salton Sea is to design the ecosystem restoration project so that the natural selenium assimilation capacity of the Sea -- which has prevented any known selenium-related wildlife impacts over the last 100 years -- is retained. Thus, the only "highly likely" case for retaining the Sea's selenium assimilation capacity is a project design that retains a 50-ft-deep lake of comparable size as the existing water

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[1] The Setmire reference is to his 1988-89 field sampling of selenium concentrations and loads in the Alamo and New Rivers which totaled 8.2 tons. Allowing for direct drains, the Whitewater River, and other sources, this figure has been adjusted to 10 tons/year. Inflows and selenium concentrations have not changed materially since 1988-89. The Authority is not aware of a more recent or more definitive analysis of selenium mass loading into the Sea.

body in either the north or south basin of the present Sea. This consideration was a major factor in the design and selection of the North Lake Plan as the Authority's preferred project in April 2004.

The Sea's natural ability as a 50-ft-deep water body to assimilate and render harmless the 10 tons/year of selenium load was documented at a meeting of 13 selenium experts convened by USGS Salton Sea Science Office in March 2003. The various selenium assimilation mechanisms these experts identified as being at work in the Sea are identified in the diagram from the meeting report shown in Figure 3. Other key findings from this meeting were:

- *Current inflows to the Sea contain low to moderate levels of selenium. However, because the inflow volume of water is so great, total selenium burden to the Salton Sea annually is equivalent to that of Kesterson Reservoir.*
- *The existing Sea appears to accommodate selenium. While most major ions increase by evaporative concentration in the Salton Sea, water-borne selenium levels are lower in the Sea than in the inflows. In contrast to major ions, selenium in water entering the Sea is diluted by the lower selenium concentration water in the Sea where it is continually removed by a variety of biological processes.*
- *Selenium is currently bioavailable through invertebrate and fish consumption of bacteria and algae in the water column or in shallow sediments. However, the greatest portion of this selenium appears to become incorporated into deep anoxic sediments as the algae and bacteria die, becoming a detrital rain. These deep sinks [in the north and south basins] have little or no biological activity, and thus for all practical purposes the selenium is biologically unavailable so long as the deep water and anoxic sediment conditions are maintained. (USGS, 2003).*

Preserving a 50-ft-deep anoxic sink as a proven long-term solution to potential wildlife impacts from selenium bioaccumulation is a unique feature of the Authority Plan among eight alternatives under consideration in the Agency's Ecosystem Restoration study. Given the Kesterson experience and the fact that providing safe, sustainable habitat for wildlife is the main objective of the Agency's legislatively mandated study, it seems implausible that any plan could be rated higher than the Authority Plan on providing the legislatively mandated wildlife values.

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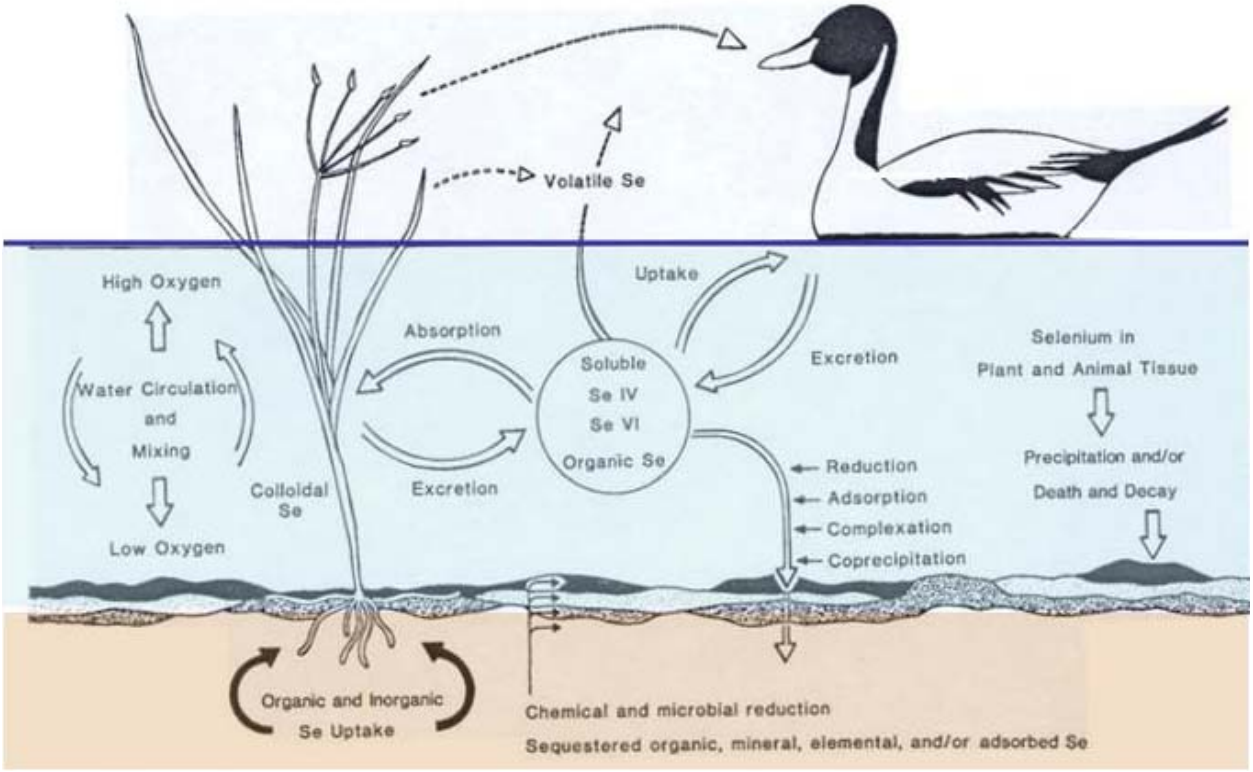

Figure 3. **Natural Selenium Assimilation Processes in Current Sea. Source: USGS Salton Sea Science Office, Selenium and the Salton Sea, March 2003 (color added). Caption in USGS Source Document: Processes for the immobilization of selenium include chemical and microbial reduction, adsorption, co-precipitation, and deposition of plan and animal tissue; mobilization processes include uptake of selenium by rooted plants and sediment oxidation due to water circulating and mixing**